Synoptic and Mesoscale Conditions associated with Persisting and Dissipating Mesoscale Convective Systems that Cross Lake Michigan

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Warm-season mesoscale convective systems (MCSs) that traverse the Great Lakes pose an important forecasting issue. Conventional wisdom suggests that mature MCSs might dissipate upon crossing lake waters that are typically cooler than the surrounding land. However, observational evidence reveals that MCSs can persist or even intensify upon crossing these relatively cool lake waters. As these MCSs interact with the lake-modified air, they undergo structural and evolutionary changes that vary from case-to-case, based on the environmental conditions present. This presentation will document environmental conditions associated with warm-season MCSs that cross Lake Michigan and examine MCS–lake interactions to ascertain the spectrum of conditions under which MCSs persist and dissipate.

Climatological results from 2002 to 2007 indicate that 43% of warm-season MCSs persisted upon crossing Lake Michigan. Persistence is favored for MCSs that cross during the evening/overnight and the mid-summer. However, MCSs can persist at other times as well, such as during the early warm season (April–June), when lake water temperatures are only 3–10°C. Consequently, the lake water temperature is not a good predictor of MCS persistence. Rather, the very shallow near-surface lake inversion (buoy air temperature at 5 m minus lake water temperature) is typically much stronger when MCSs persist, particularly in the early warm season. Additionally, MCSs often persist in association with an intense low-level jet (LLJ) stream, and large amounts of CAPE and shear immediately downstream of Lake Michigan. Synoptic-scale composites generally agree with climatological results and show that MCSs usually persist in the equatorward-entrance region of a stronger upper-level jet stream than MCSs that dissipate.
Two MCS case studies, one from 7–8 June 2008 that persisted and one from 4–5 June 2005 that dissipated, will accentuate climatological and compositing results. These case studies will utilize real and simulated data to highlight the differing combinations of environmental and lake conditions that distinguish between MCSs that persist and dissipate. For instance, MCSs that persist usually are associated with convective cold pools that are much deeper than the very shallow, stable dome of cold air over Lake Michigan. Persisting MCSs typically feed on “surface” flow characteristic of adjoining landmasses that is advected by a strong LLJ above this lake cold dome.